AP Calculus Professional Development

FORMATIVE ASSESSMENT FRAMEWORK

The Formative Assessment Framework has been designed to help you assess and respond to student understanding during the course of your teaching. Good responsive teaching *probes* student understanding by creating opportunities for students to display their thinking, *diagnoses* student understanding by analyzing what student responses reveal about their thinking, and *responds* to students' level of understanding appropriately.

1. ***Probe*** for student understanding.

Create opportunities for individuals and the larger class to display their thinking. Evaluate whether an issue is particular to one student or may be an issue for the larger class.

Strategies

Consider the following strategies to probe both individual and group understanding:

Ask students to explain their reasoning.
Ask students to restate their understanding.
Ask students to clarify their understanding.
Ask students to extend or elaborate a response.
Ask students to evaluate if a problem has been solved correctly, identifying errors.
Ask students to apply their understanding to a new problem.
Ask a series of questions that probe understanding of different aspects of a concept.
Ask a series of questions that probe depth of understanding of a concept.
Observe students as they work on tasks that require reasoning and representation.
Have students display their understanding through multiple representations.
Have students write their understanding or describe steps they used to solve a problem.
Ask students to restate a classmate's understanding.
Ask students to offer alternative solutions or problem-solving strategies.
Observe students as they work collaboratively in pairs or small groups on tasks that require reasoning, representation, and communication.
Have students use appropriate and precise mathematical vocabulary and notation.

2. *Develop your* ***diagnosis*** of student understanding.

Issues related to students' understanding vary: students may not have sufficient background knowledge to understand the topic; students may not have understood the question or problem being posed; students may have alternative conceptions or misconceptions of a topic that hinder their correct understanding of the topic; students may have tentative understandings that need to be extended and deepened. Diagnosing their understanding is key to deciding upon an appropriate response. Preliminary diagnoses often lead to further probing to better diagnose what is at issue and how you can best respond.

Strategies

When diagnosing student understanding, consider the following:

Is the response the result of good thinking?
Does the response demonstrate the desired depth of understanding?
Is the response an alternative correct response?

Is the response the result of misinterpreting the question or problem?
Is the response the result of not having the necessary vocabulary or mathematical notation to communicate understanding?
Is the response the result of a computational error?
Is the response the result of limited conceptual understanding?
Is the student operating under a misconception that is hindering correct understanding?

Consider probing further to validate your diagnosis.
Evaluate whether the condition diagnosed is shared by other students.

3. ***Respond*** to your diagnosis.

A diagnosis should lead to an appropriate instructional response. Good responses don't focus on correcting students' errors, but rather on leading students to desired understandings and sound thinking that will enable them to correct their own errors. Responsive teachers do this in a way that values students' efforts, builds their self-confidence, and encourages them to view themselves as contributing members in a community of learners building shared understandings.

Strategies

Consider the following strategies to lead students to better understandings:

Reread, restate, or reframe the question or problem.
Allow students the opportunity to reconsider, revise, or extend their initial response.
Ask nonjudgmental questions that guide students toward desired understandings.
Back up and establish shared foundational understandings on which new understandings can be built.
Encourage students to explain a solution to a peer.
Affirm alternative correct responses or problem-solving strategies. Discuss alternatives and help students evaluate the merits of each. Acknowledge times when you need to reflect on and research their proposed novel solutions.
Create scenarios that enable students to discover the inconsistencies or contradictions implied by their misconceptions.
Review missing background knowledge.
Use manipulatives to make the problem more concrete.
Make connections to other problems, concepts, or real-world applications.
Use direct instruction only when appropriate.